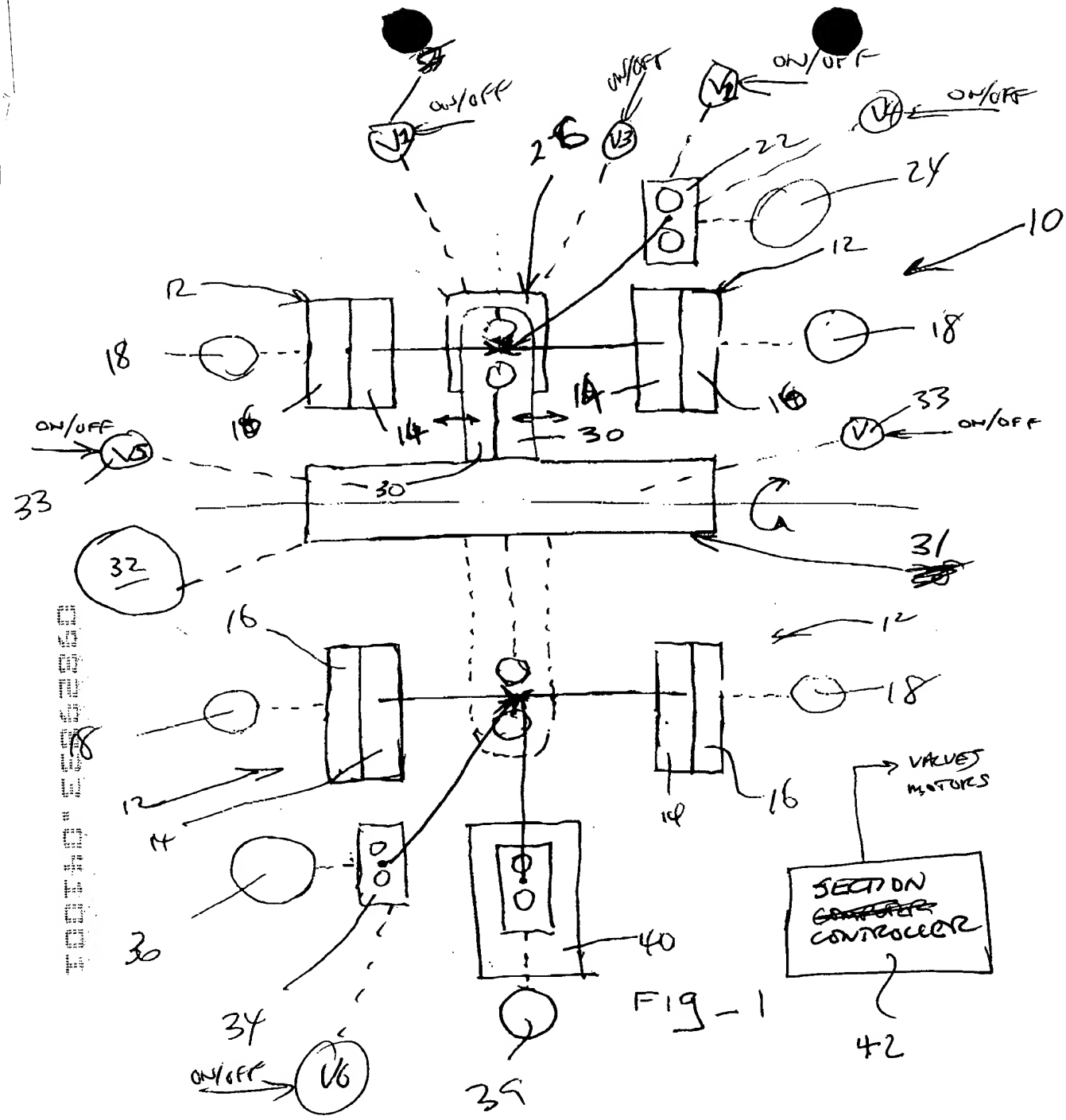
ON/OFF
V1
V2
V3
V4
V5
V6
26
22
24
10
12
18
16
14
30
33
31
32
34
36
40
42
VALVES MOTORS
SECTION CONTROLLER

FIG-1

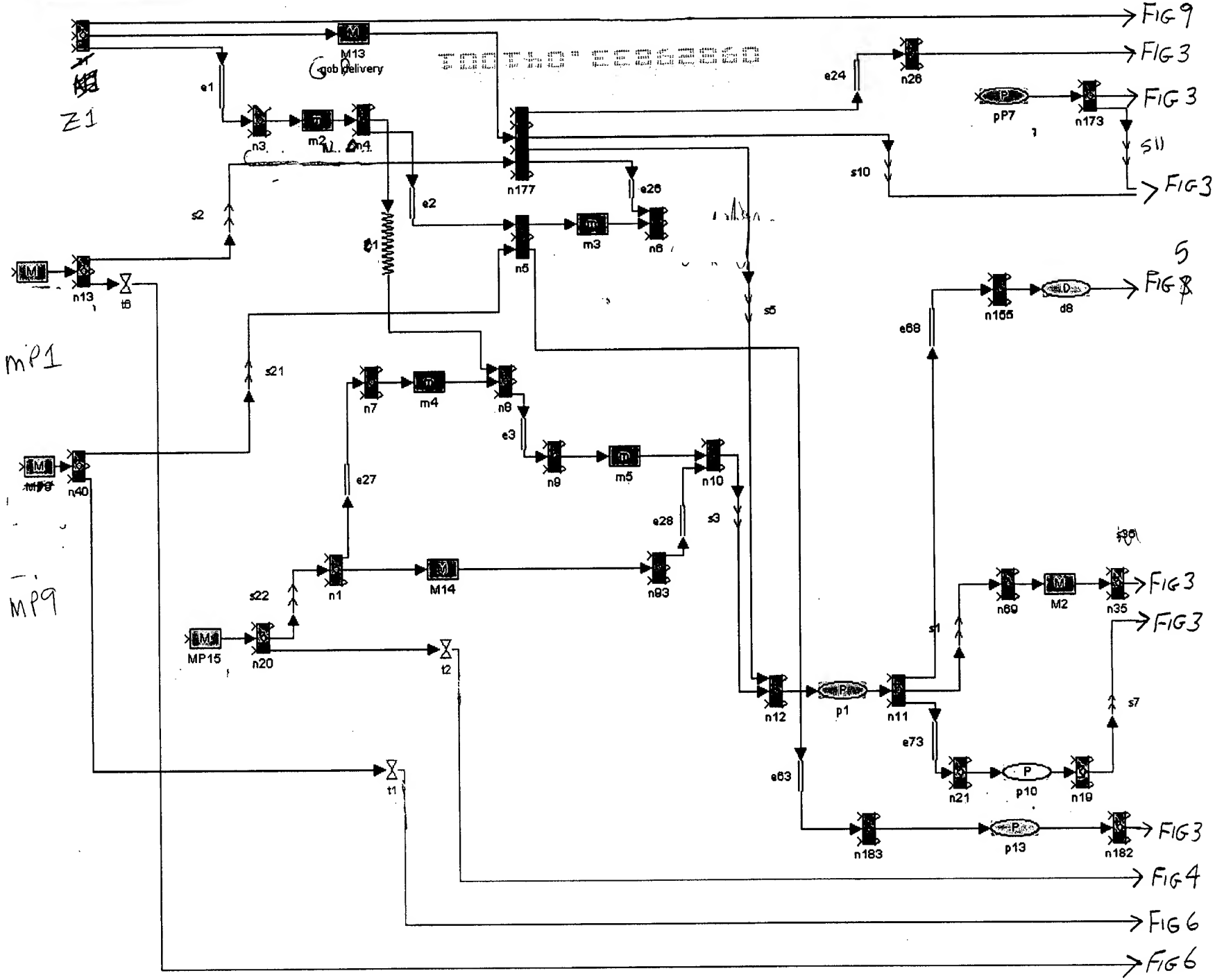
FIG 9
FIG 3
FIG 3
FIG 3
FIG 3
FIG 8
FIG 3
FIG 3
FIG 4
FIG 6
FIG 6
M13
Gob delivery
e1
n3
m2
n4
n177
e24
n26
pP7
n173
s11
s10
e2
e26
m3
n6
s2
e1
n5
s5
n13
t6
mP1
n155
d8
e68
s21
n7
m4
n8
e3
n9
m5
n10
n40
e27
e28
s3
s22
n1
M14
n93
n69
M2
n35
s1
MP15
n20
t2
n12
p1
n11
s7
e73
e63
n21
p10
n19
t1
n183
p13
n182
Z1
mP9
FIG 2

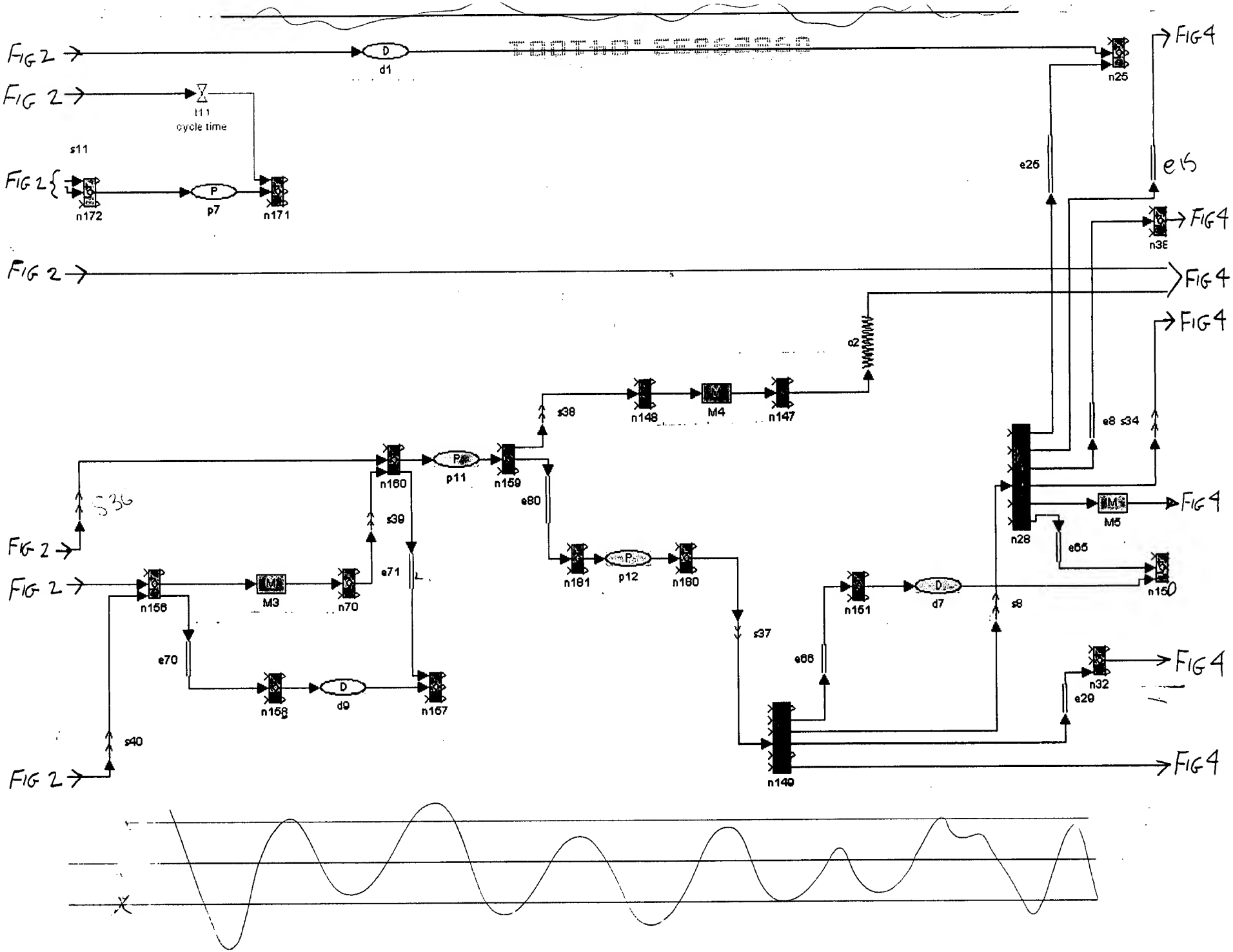
FIG 2
FIG 2
FIG 2
FIG 2
FIG 2
FIG 2
FIG 4
FIG 4
FIG 4
FIG 4
FIG 4
FIG 4
D
d1
t11
cycle time
s11
P
p7
n172
n171
n25
e25
e15
n38
n148
M4
n147
R2
s38
n160
P
p11
n159
e80
s36
s39
e71
n156
M3
n70
e70
n158
D
d9
n167
n181
P
p12
n180
s37
n149
n151
D
d7
s8
n28
e8 s34
M5
e65
n150
e66
n32
e29
s40

FIG 3

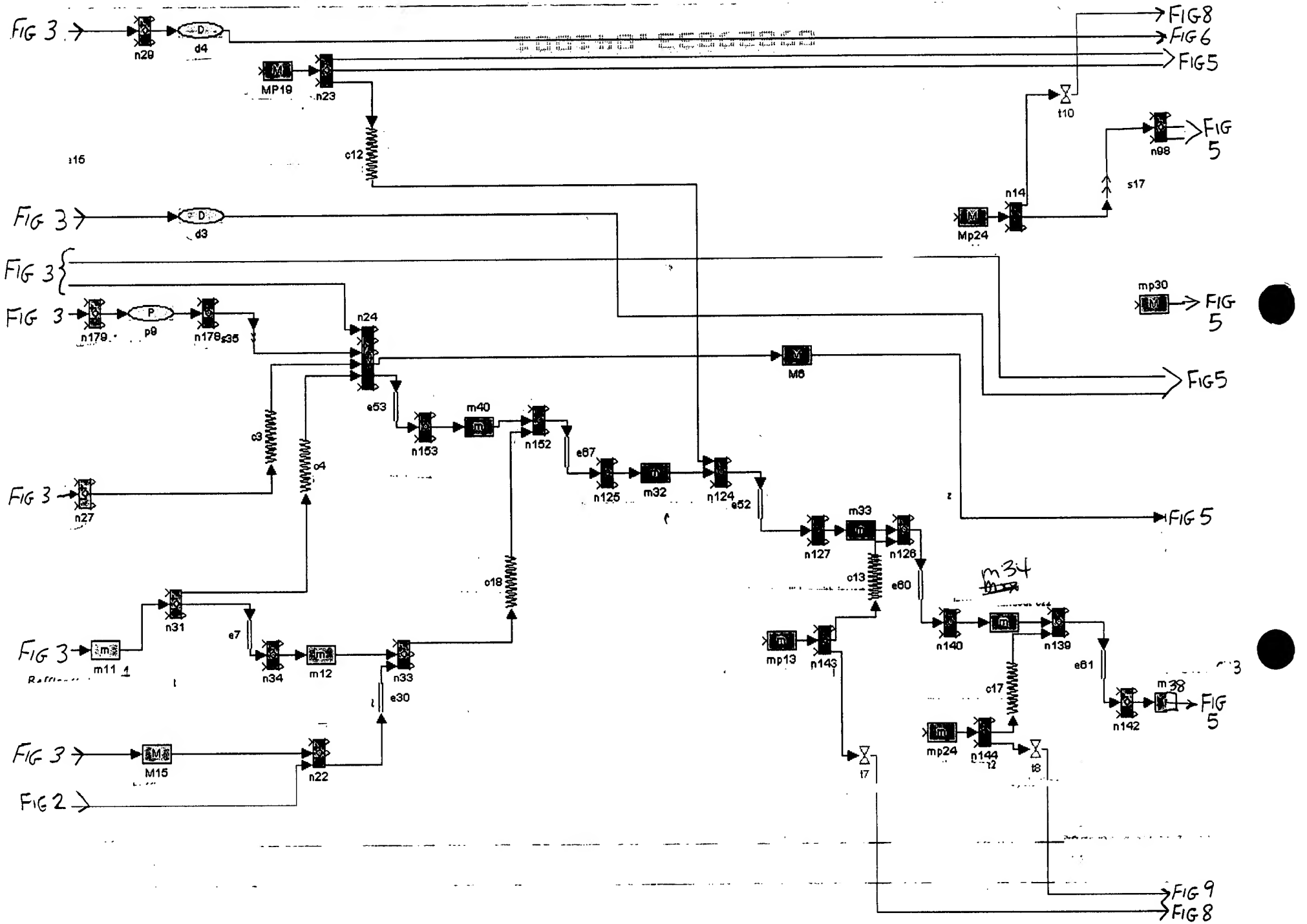
FIG 3
n29
d4
MP19
n23
c12
FIG8
FIG6
FIG5
t10
n98
FIG 5
s17
n14
Mp24
FIG 3
d3
FIG 3
FIG 3
n179
p9
n178
s35
n24
M6
mp30
FIG 5
FIG5
e53
m40
n153
n152
e67
n125
m32
n124
e52
c3
c4
FIG 3
n27
FIG 5
m33
n127
n126
c13
e60
m34
c18
FIG 3
m11
n31
e7
n34
m12
n33
e30
mp13
n143
n140
n139
e61
c17
m38
FIG 5
n142
mp24
n144
t2
t8
t7
FIG 3
M15
n22
FIG 2
FIG 9
FIG 8

FIG 4

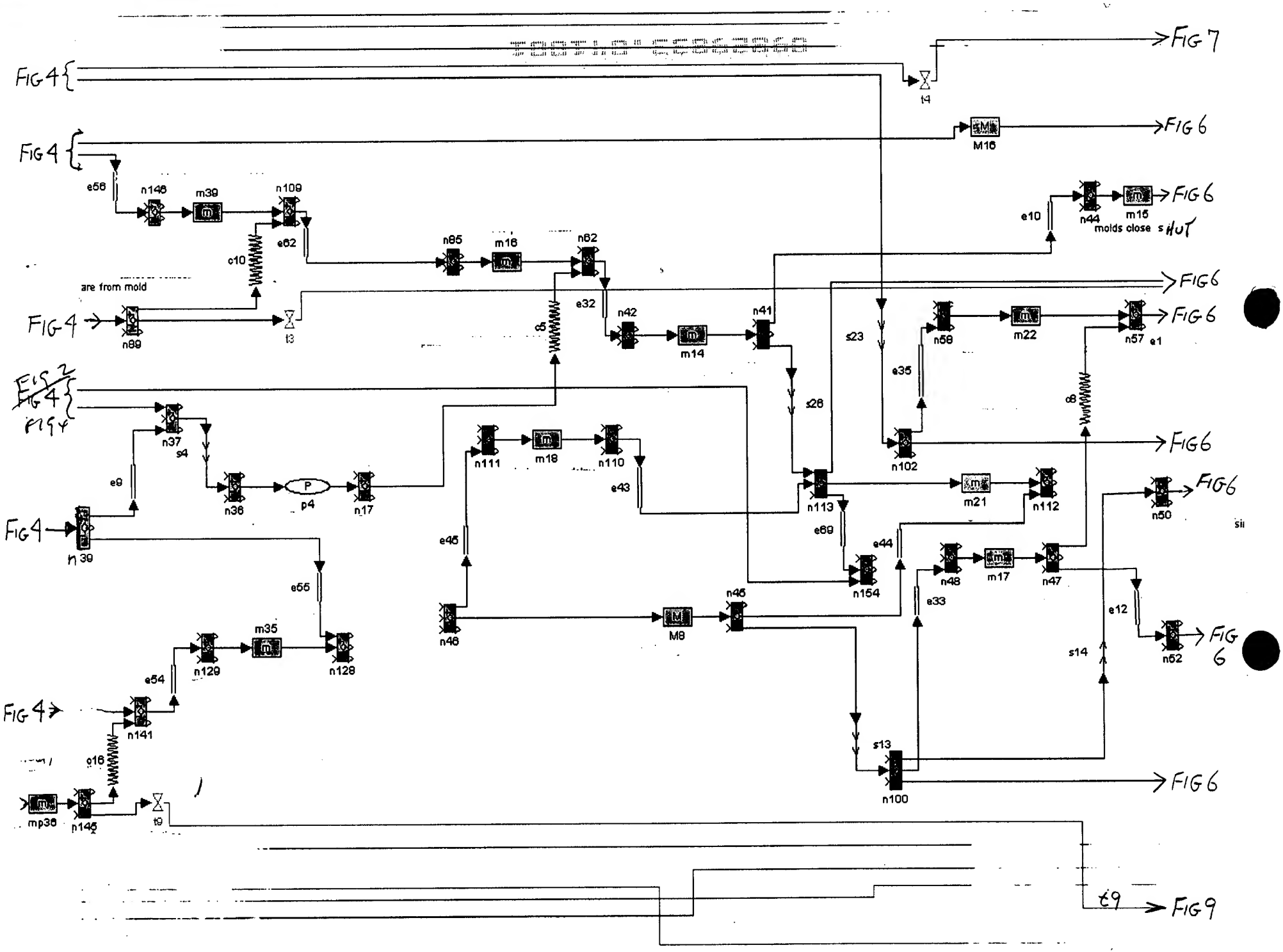
FIG 7
FIG 4
t4
FIG 6
M16
FIG 4
e56
n146
m39
n109
e62
c10
n85
m16
n62
e10
n44
m15
molds close
SHUT
FIG 6
are from mold
FIG 4
n89
t3
e32
c5
n42
m14
n41
s23
n58
m22
n57
e1
FIG 6
FIG 2
FIG 4
FIG 4
e35
c8
n37
s4
n111
m18
n110
s26
n102
FIG 6
e9
n36
P
p4
n17
e43
n113
m21
n112
FIG 6
FIG 4
n39
e45
e69
e44
n154
n48
m17
n47
n50
sii
e55
n46
M8
n46
e33
e12
m35
n129
n128
n52
FIG 6
e54
s14
FIG 4
n141
c16
s13
n100
FIG 6
mp36
n145
t9
t9
FIG 9

FIG 5

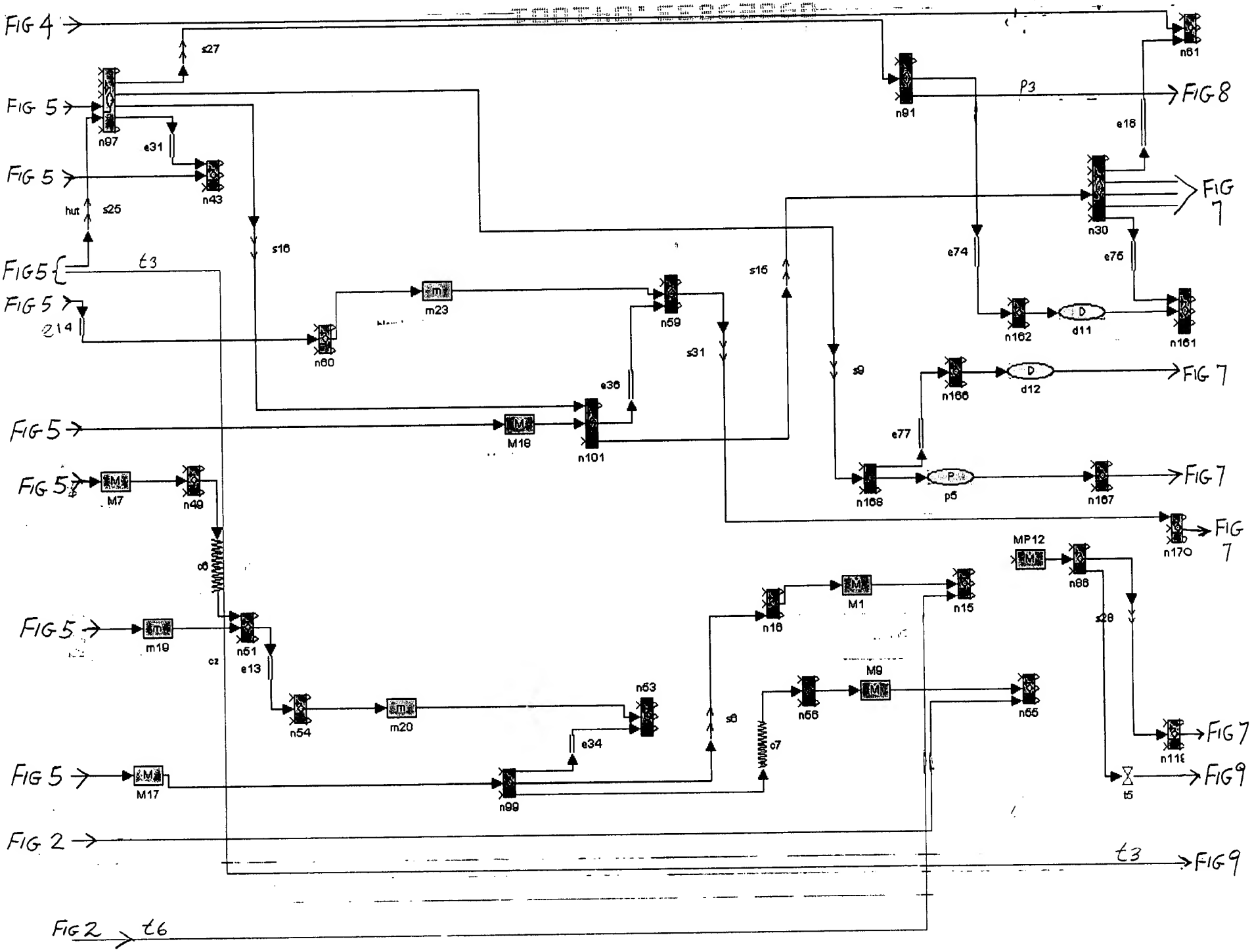
FIG 4
FIG 5
FIG 5
FIG 5
FIG 5
FIG 5
FIG 5
FIG 5
FIG 5
FIG 2
FIG 2
s27
n97
e31
n43
hut
s25
s16
t3
z14
n60
m23
n59
s31
e36
M18
n101
s16
s9
n91
P3
FIG 8
n61
e16
n30
FIG 7
e74
e75
n162
d11
n161
n166
d12
FIG 7
e77
n168
p5
n167
FIG 7
n170
FIG 7
M7
n49
s8
m19
n51
e13
cz
n54
m20
n53
e34
n99
s8
c7
n16
M1
n15
n66
M9
n65
MP12
n86
s28
n118
FIG 7
t5
FIG 9
M17
t3
FIG 9
t6

FIG 6

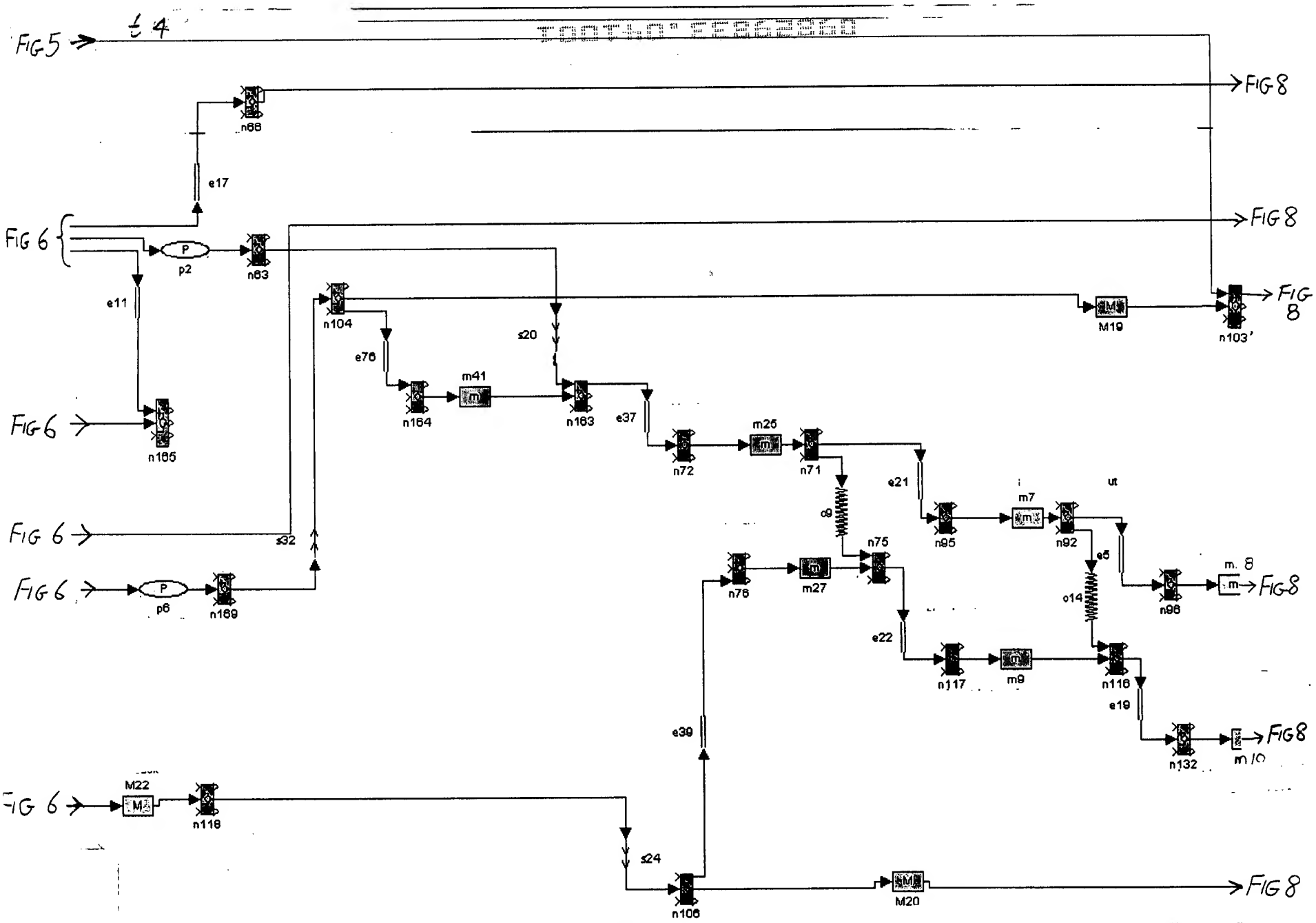
FIG 5
4
FIG 8
n66
e17
FIG 6
P
p2
n63
FIG 8
e11
n104
M19
n103'
FIG 8
≤20
e76
m41
n164
n163
e37
FIG 6
n165
m25
n72
n71
e21
i
ut
m7
FIG 6
≤32
e9
n75
n95
n92
e5
m. 8
FIG 8
FIG 6
P
p6
n169
n76
m27
e14
n98
e22
n117
m9
n116
e19
e39
FIG 8
m 10
n132
FIG 6
M22
M
n118
≤24
n106
M20
FIG 8

Fig 7

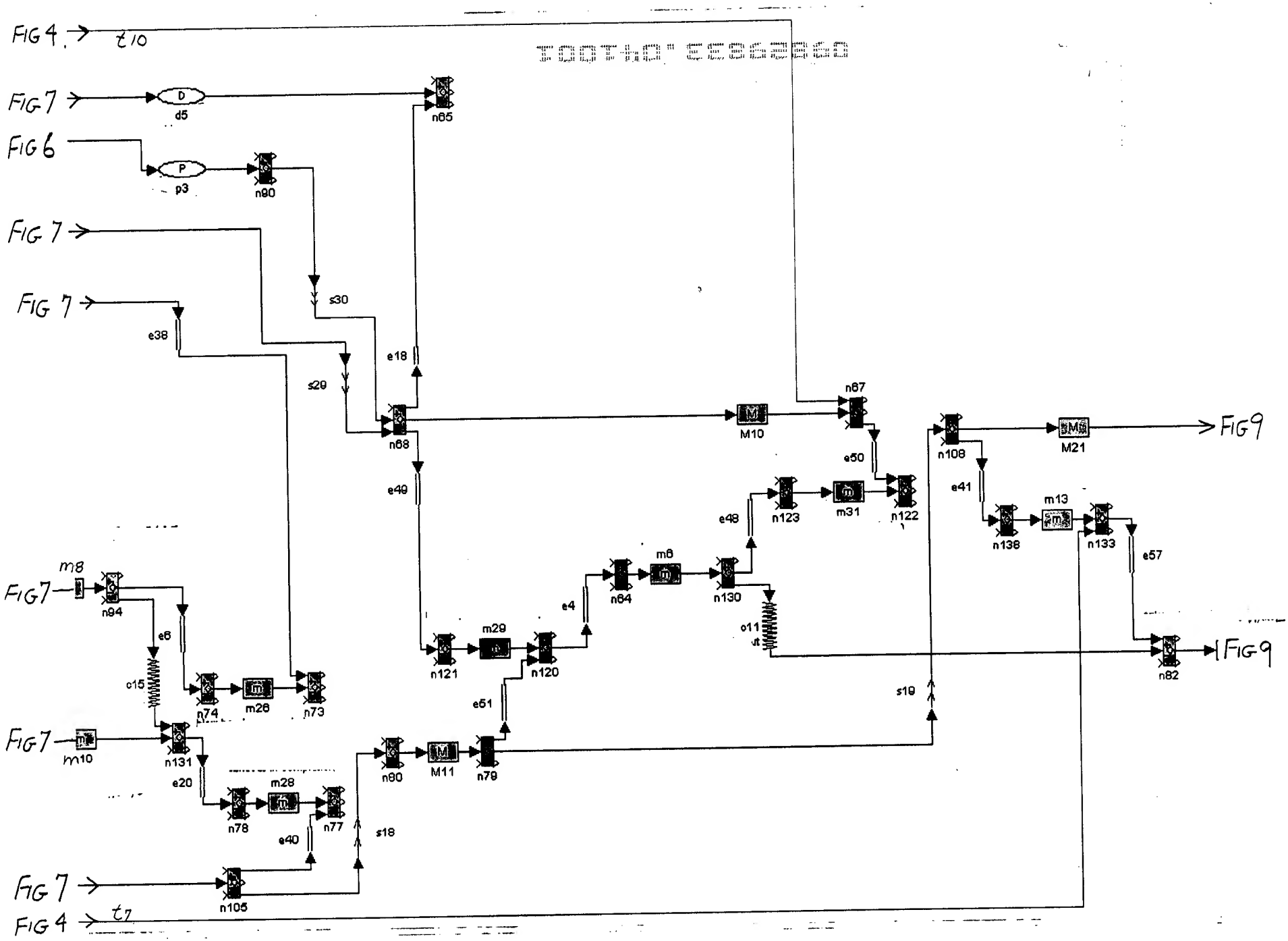
FIG 4 → t10
FIG 7 →
D
d5
n65
FIG 6
P
p3
n90
FIG 7 →
FIG 7 →
s30
e38
e18
s29
n68
M10
n67
e50
n108
M21
→ FIG 9
e49
e48
n123
m31
n122
e41
m13
n138
n133
e57
m8
FIG 7 →
n94
e6
n130
m6
n64
e4
o11
n121
m29
n120
n82
FIG 9
o15
n74
m26
n73
s19
e51
FIG 7 →
m10
n131
e20
n80
M11
n79
m28
n78
n77
e40
s18
FIG 7 →
n105
FIG 4 → t7

FIG 8

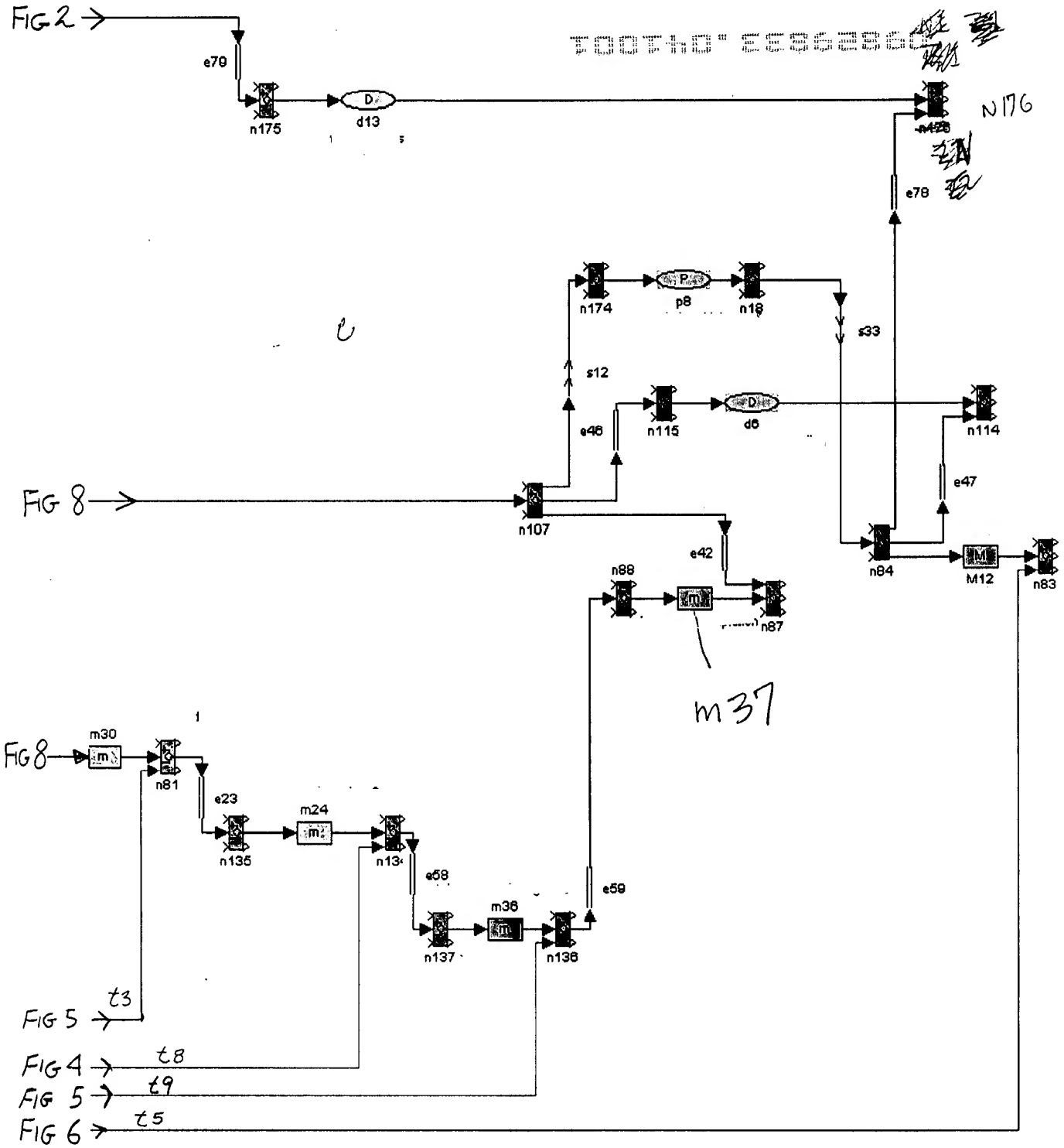
FIG 2
e79
n175
d13
N176
e78
n174
p8
n18
s33
s12
e46
n115
d6
n114
FIG 8
n107
e47
e42
n84
M12
n83
n88
n87
m37
FIG 8
m30
n81
e23
n135
m24
e58
m36
n137
n136
e59
FIG 5
t3
FIG 4
t8
FIG 5
t9
FIG 6
t5

Fig 9

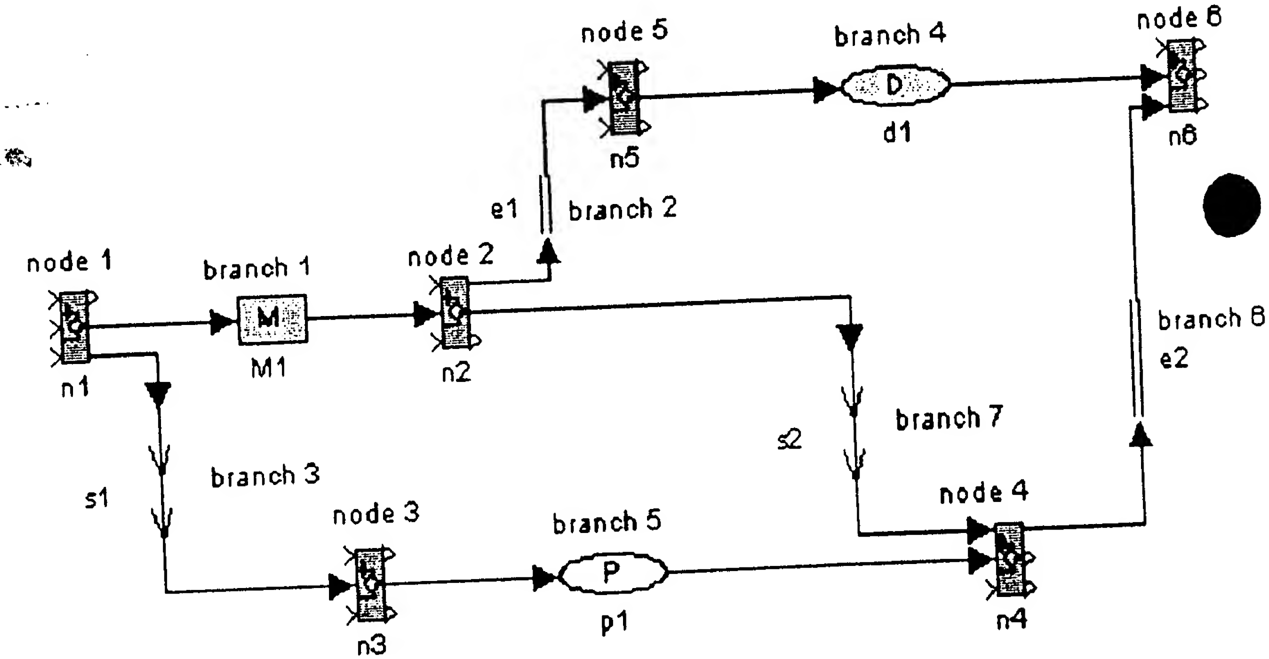
node 1
n1
branch 1
M
M1
node 2
n2
e1
branch 2
node 5
n5
branch 4
D
d1
node 6
n6
branch 3
s1
node 3
n3
branch 5
P
p1
s2
branch 7
node 4
n4
branch 6
e2

Fig_10

		G	H
1	**Events**	ON	OFF
2	Gob Interceptor	334	14
3	Blanks Close	324	130
4	Blanks Open	130	321
5	Plunger Up	33	123
6	First Baffle	9	125
7	Plunger Down	127	327
8	Funnel	1	150
9	Settle Blow	1	1
10	Plunger Cooling	150	260
11	Invert	200	260
12	Neckring Open	274.5	283
13	Revert	282	172
14	Molds Close/Open	229	170
15	Mold Cooling	10	150
16	Blowhead	290	113
17	Final Blow	348	120
18	Take Out IN	137	197
19	Tongs Close	178	78
20	Take Out OUT	197	90

Fig - 11

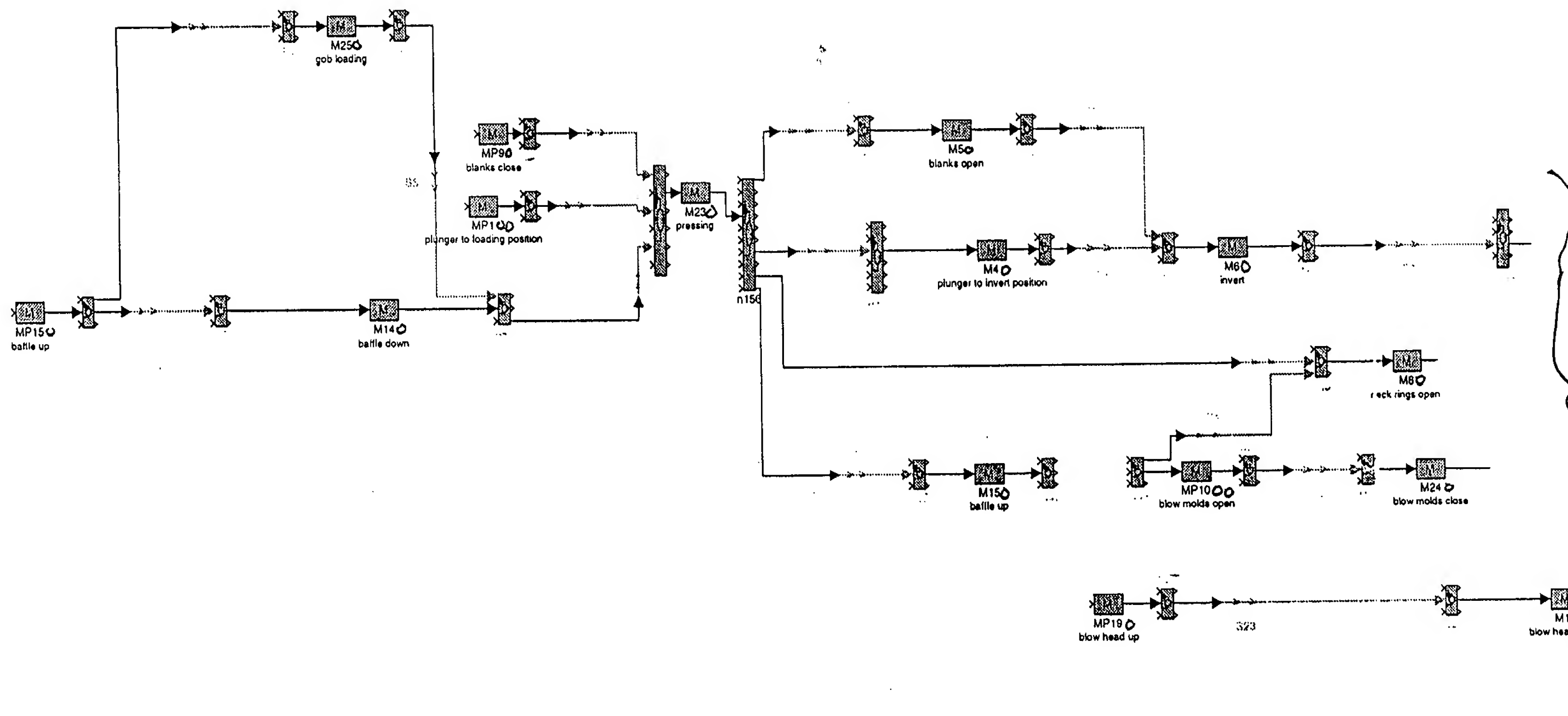

Fig 12B

FIG_12A

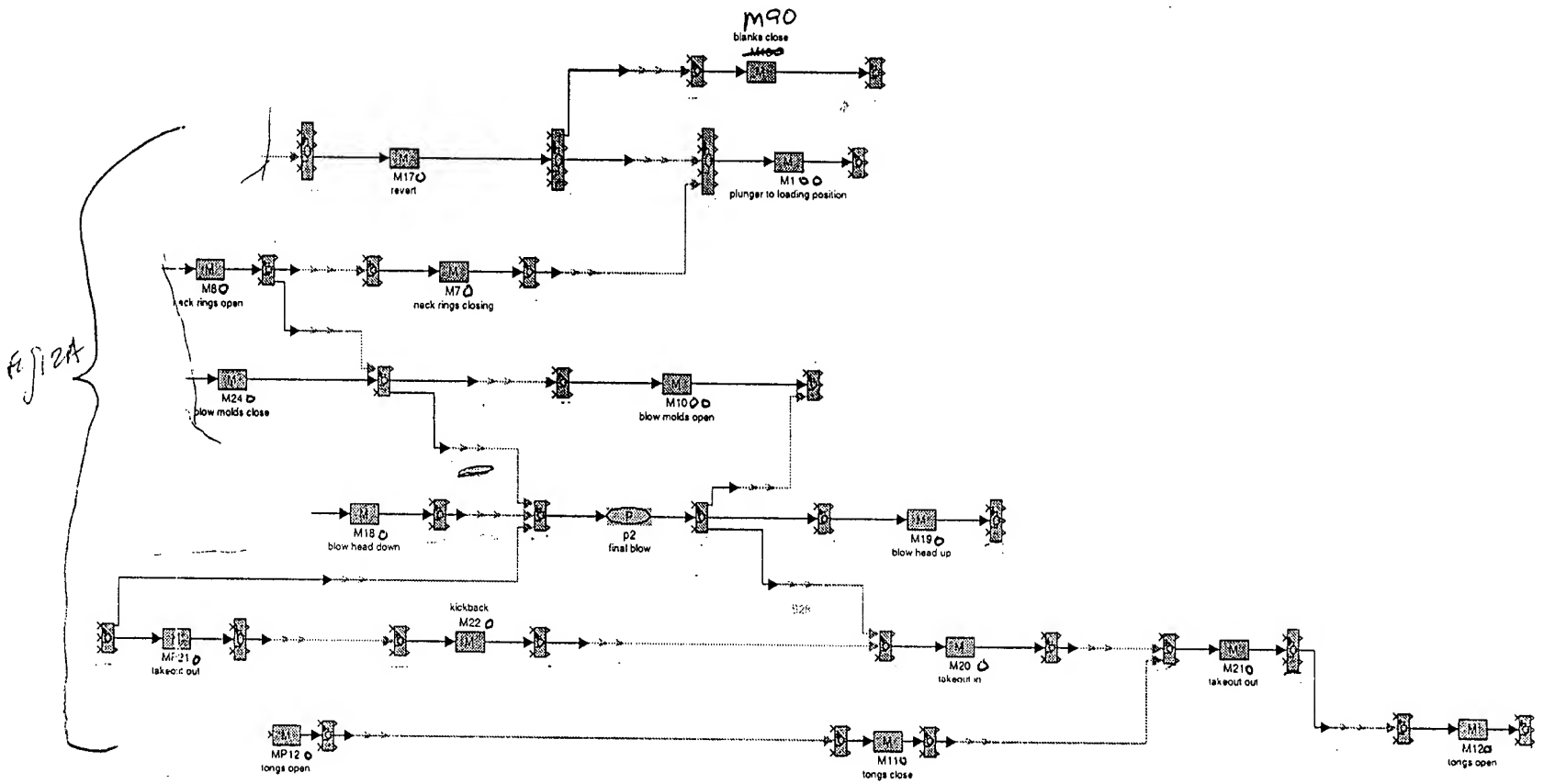

Fig 12A

Fig 12B

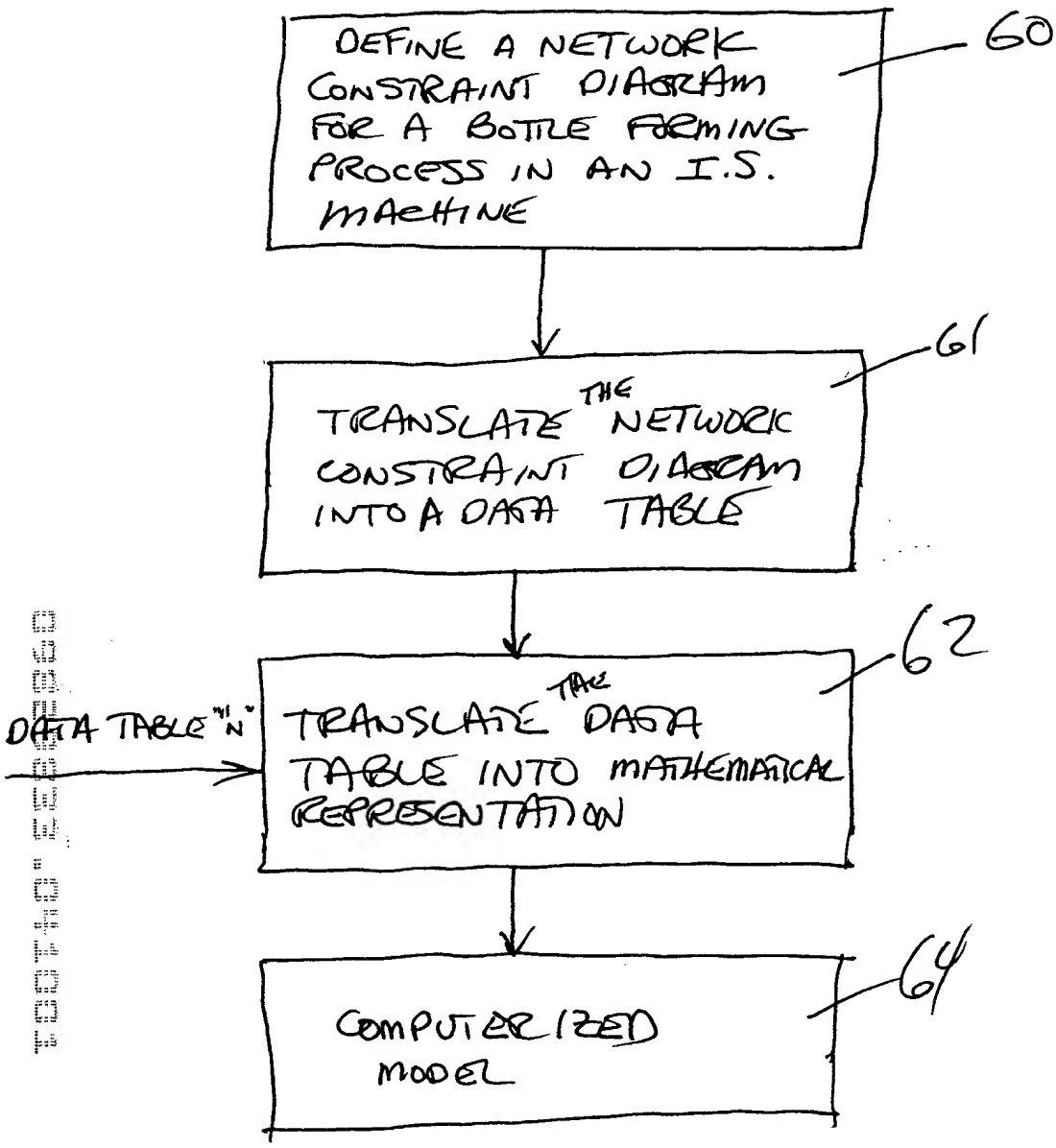
DEFINE A NETWORK CONSTRAINT DIAGRAM FOR A BOTTLE FORMING PROCESS IN AN I.S. MACHINE
60
TRANSLATE THE NETWORK CONSTRAINT DIAGRAM INTO A DATA TABLE
61
DATA TABLE "1...N"
TRANSLATE THE DATA TABLE INTO MATHEMATICAL REPRESENTATION
62
COMPUTERIZED MODEL
64

Fig_13

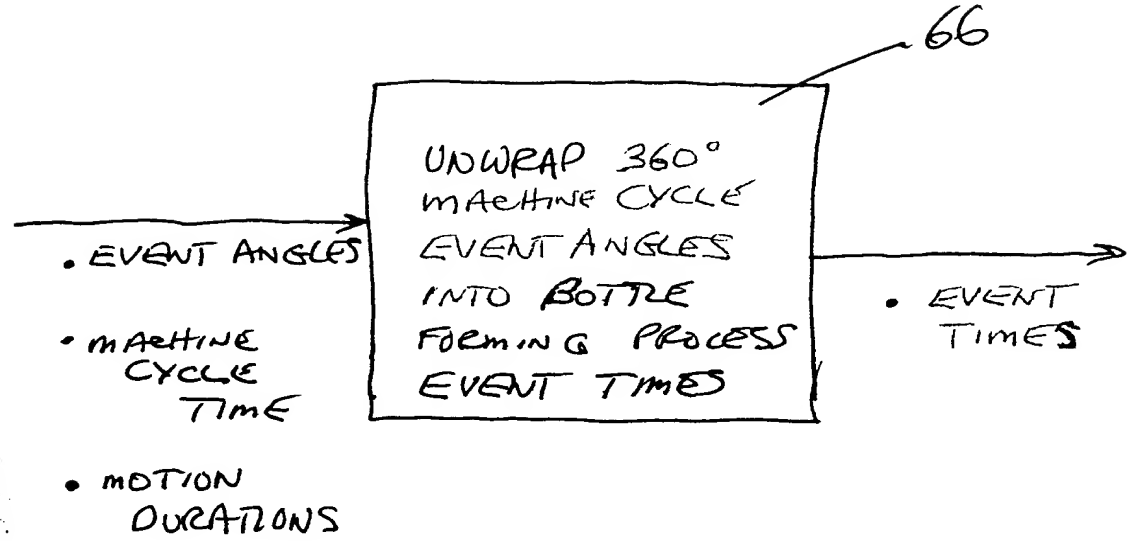
66
UNWRAP 360° MACHINE CYCLE EVENT ANGLES INTO BOTTLE FORMING PROCESS EVENT TIMES
• EVENT ANGLES
• MACHINE CYCLE TIME
• MOTION DURATIONS
• EVENT TIMES

FIG - 14

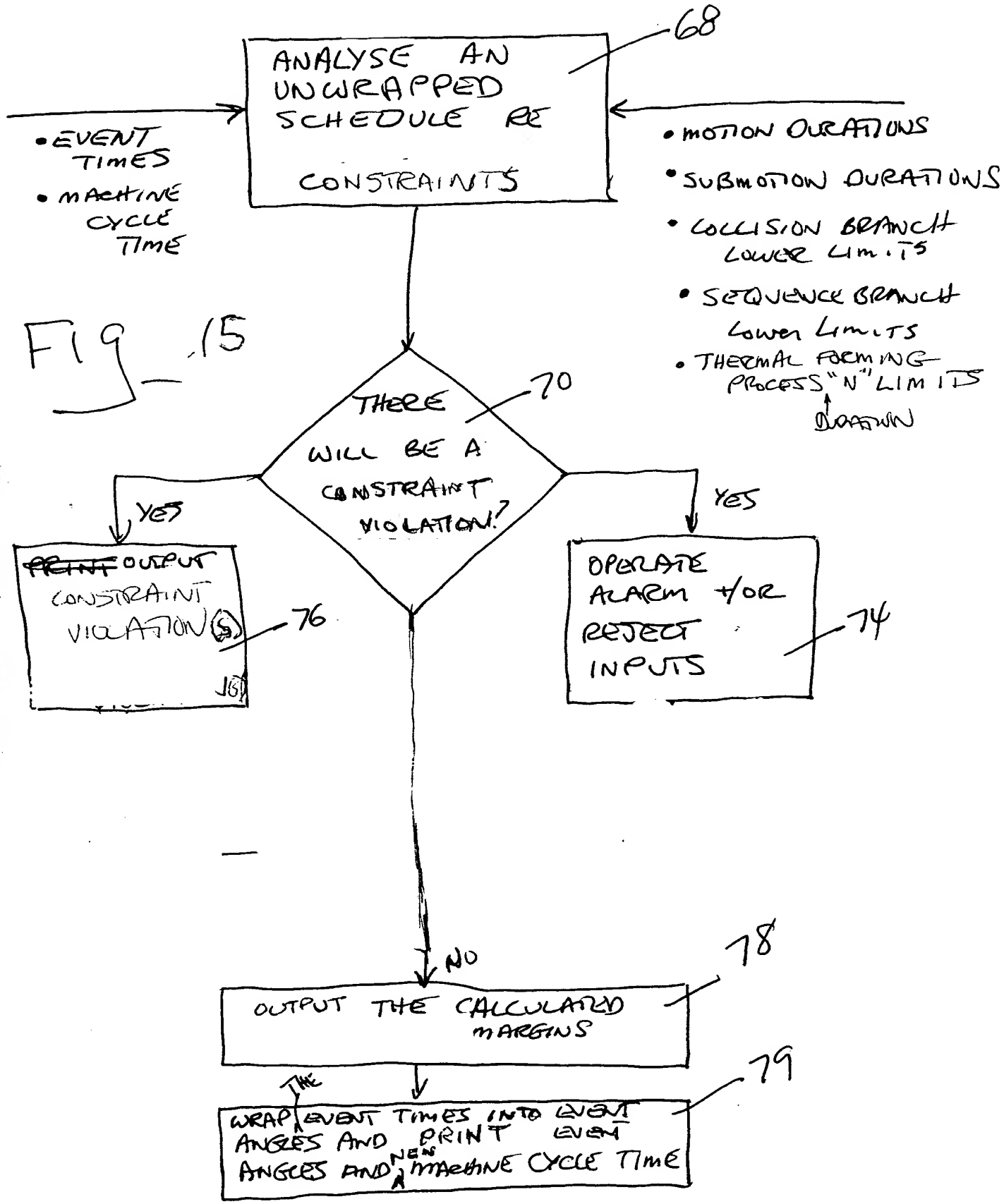
ANALYSE AN UNWRAPPED SCHEDULE RE CONSTRAINTS
68
• EVENT TIMES
• MACHINE CYCLE TIME
• MOTION DURATIONS
• SUBMOTION DURATIONS
• COLLISION BRANCH LOWER LIMITS
• SEQUENCE BRANCH LOWER LIMITS
• THERMAL FORMING PROCESS "N" LIMITS
DRAWN
THERE WILL BE A CONSTRAINT VIOLATION?
70
YES
YES
~~PRINT~~ OUTPUT CONSTRAINT VIOLATION(S)
76
OPERATE ALARM +/OR REJECT INPUTS
74
NO
OUTPUT THE CALCULATED MARGINS
78
WRAP THE EVENT TIMES INTO EVENT ANGLES AND PRINT EVEN ANGLES AND NEW MACHINE CYCLE TIME
79

FIG. 15

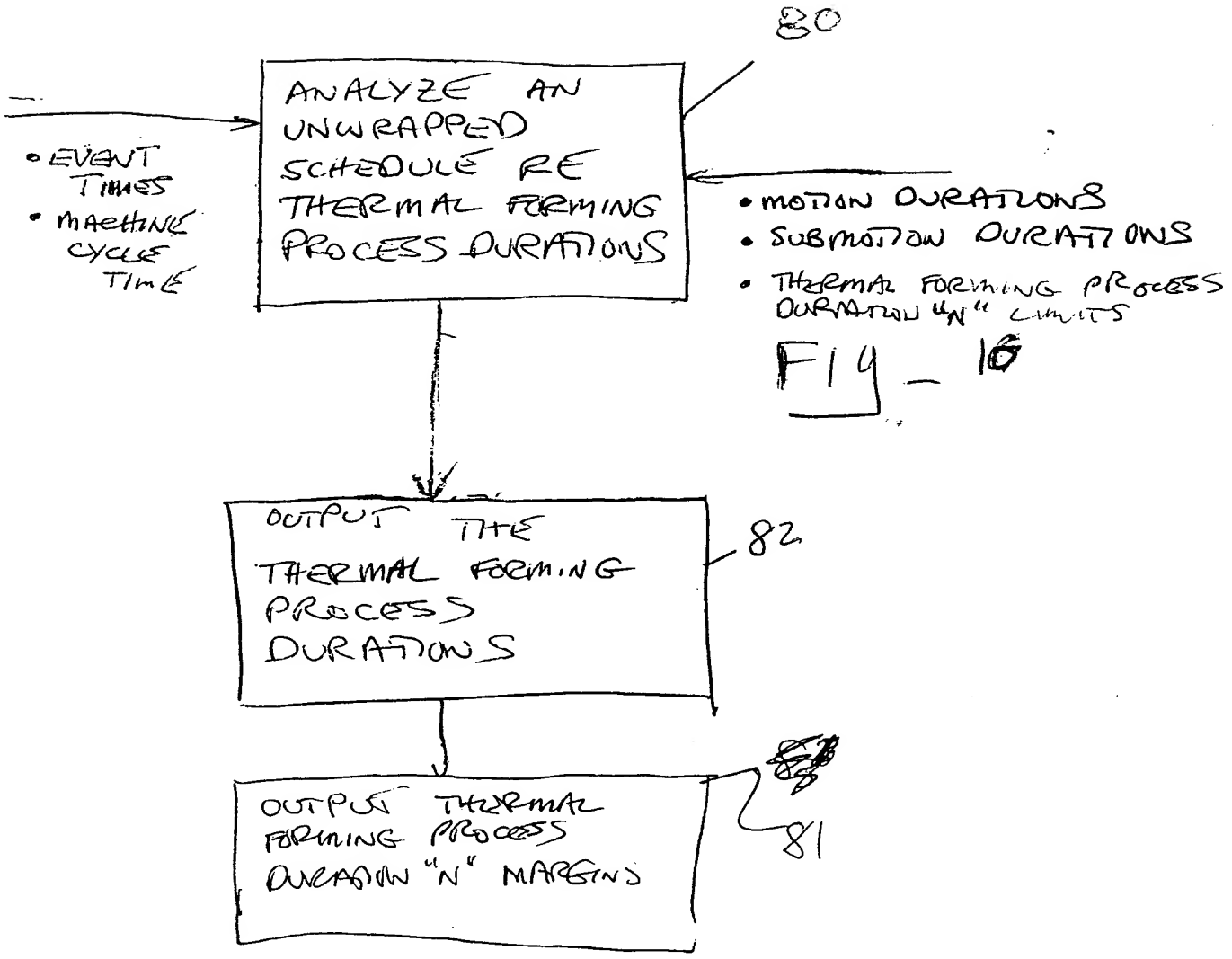
80
ANALYZE AN UNWRAPPED SCHEDULE RE THERMAL FORMING PROCESS DURATIONS
• EVENT TIMES
• MACHINE CYCLE TIME
• MOTION DURATIONS
• SUBMOTION DURATIONS
• THERMAL FORMING PROCESS DURATION "N" LIMITS
OUTPUT THE THERMAL FORMING PROCESS DURATIONS
82
OUTPUT THERMAL FORMING PROCESS DURATION "N" MARGINS
81

FIG. 16

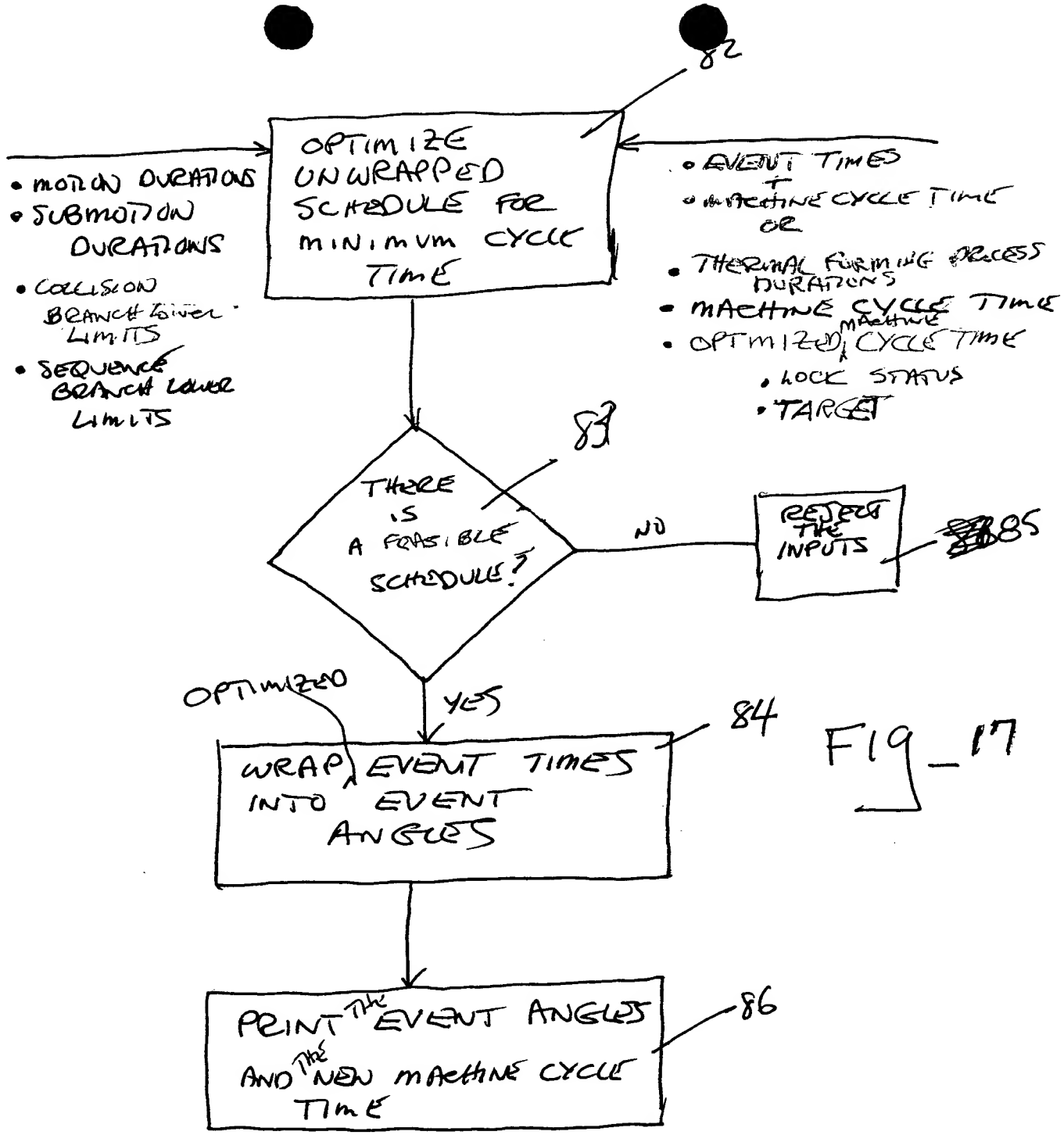
82
OPTIMIZE UNWRAPPED SCHEDULE FOR MINIMUM CYCLE TIME
• MOTION DURATIONS
• SUBMOTION DURATIONS
• COLLISION BRANCH LOWER LIMITS
• SEQUENCE BRANCH LOWER LIMITS
• EVENT TIMES
+
• MACHINE CYCLE TIME
OR
• THERMAL FORMING PROCESS DURATIONS
• MACHINE CYCLE TIME
• OPTIMIZED MACHINE CYCLE TIME
• LOCK STATUS
• TARGET
83
THERE IS A FEASIBLE SCHEDULE?
NO
REJECT THE INPUTS
85
YES
OPTIMIZED
84
WRAP EVENT TIMES INTO EVENT ANGLES
PRINT THE EVENT ANGLES AND THE NEW MACHINE CYCLE TIME
86

Fig_17

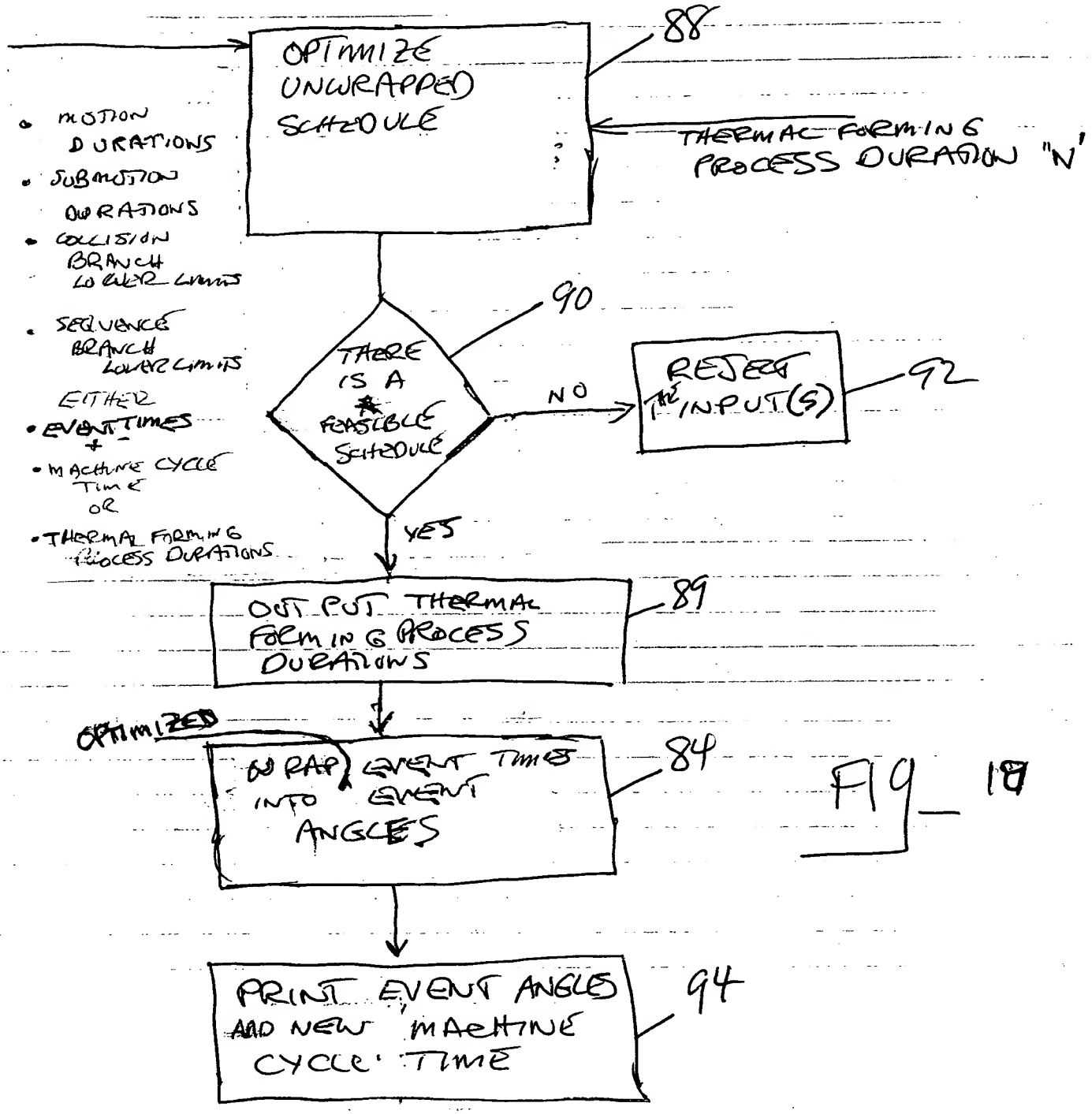
OPTIMIZE UNWRAPPED SCHEDULE
88
THERMAL FORMING PROCESS DURATION "N"
• MOTION DURATIONS
• SUBMOTION DURATIONS
• COLLISION BRANCH LOWER LIMITS
• SEQUENCE BRANCH LOWER LIMITS
EITHER
• EVENT TIMES
+
• MACHINE CYCLE TIME
OR
• THERMAL FORMING PROCESS DURATIONS
THERE IS A FEASIBLE SCHEDULE
90
NO
REJECT THE INPUT(S)
92
YES
OUTPUT THERMAL FORMING PROCESS DURATIONS
89
OPTIMIZED
UNWRAP EVENT TIMES INTO EVENT ANGLES
84
PRINT EVENT ANGLES AND NEW MACHINE CYCLE TIME
94

FIG_ 19

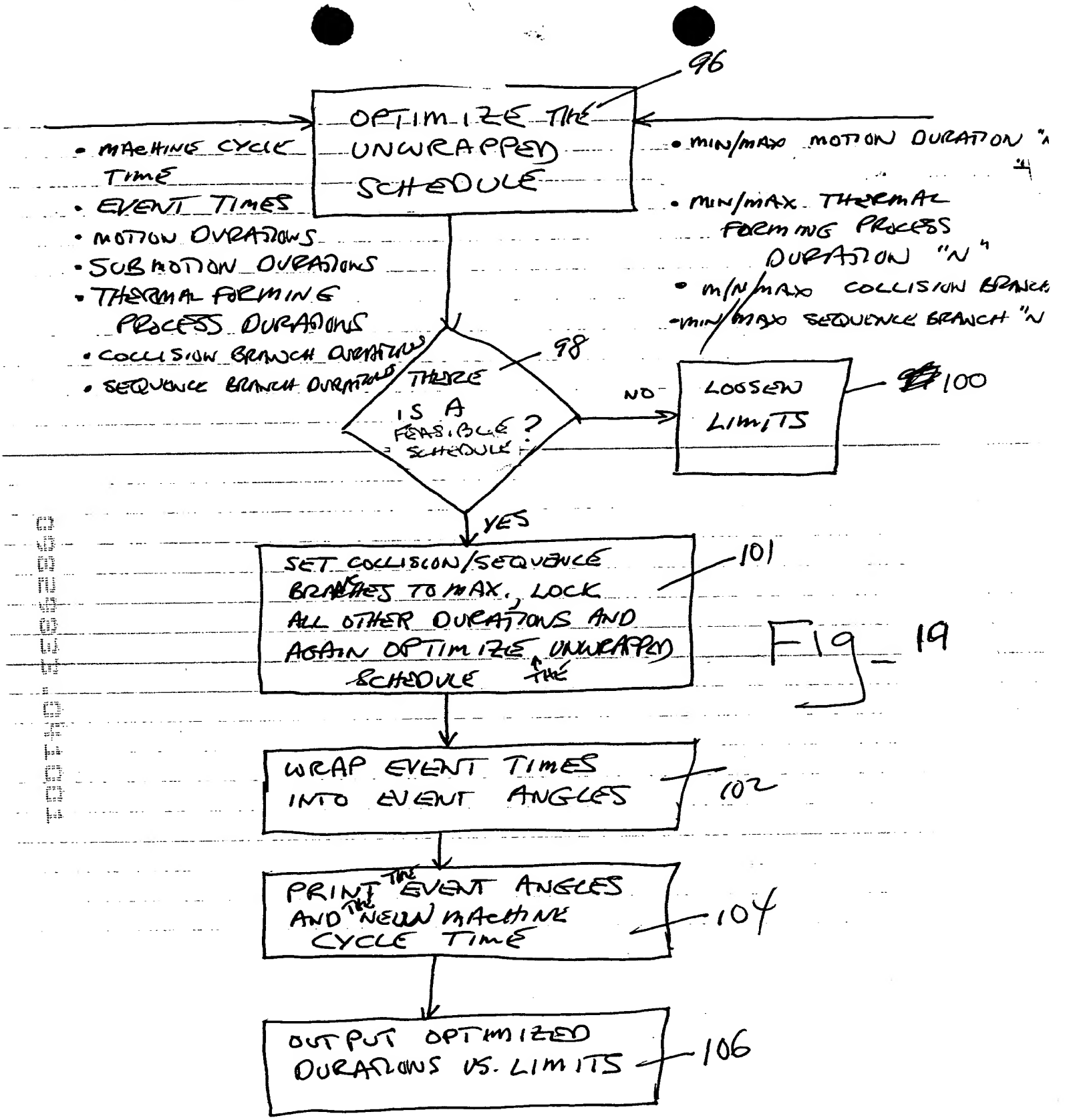
96
OPTIMIZE THE UNWRAPPED SCHEDULE
• MACHINE CYCLE TIME
• EVENT TIMES
• MOTION DURATIONS
• SUB MOTION DURATIONS
• THERMAL FORMING PROCESS DURATIONS
• COLLISION BRANCH DURATIONS
• SEQUENCE BRANCH DURATIONS
• MIN/MAX MOTION DURATION "N"
• MIN/MAX THERMAL FORMING PROCESS DURATION "N"
• MIN/MAX COLLISION BRANCH
• MIN/MAX SEQUENCE BRANCH "N
98
IS A FEASIBLE SCHEDULE?
THERE
NO
LOOSEN LIMITS
100
YES
SET COLLISION/SEQUENCE BRANCHES TO MAX., LOCK ALL OTHER DURATIONS AND AGAIN OPTIMIZE THE UNWRAPPED SCHEDULE
101
WRAP EVENT TIMES INTO EVENT ANGLES
102
PRINT THE EVENT ANGLES AND THE NEW MACHINE CYCLE TIME
104
OUTPUT OPTIMIZED DURATIONS VS. LIMITS
106

Fig. 19

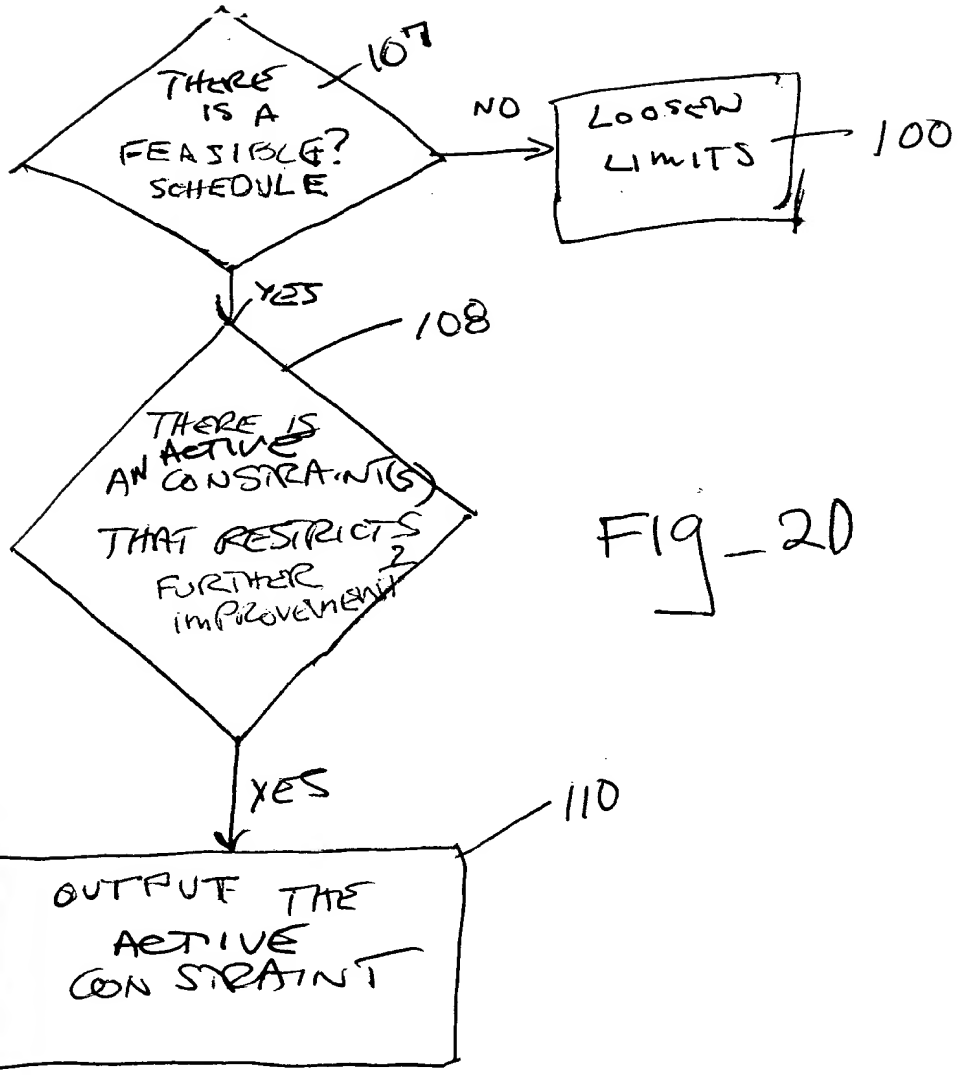
THERE IS A FEASIBLE SCHEDULE?
107
NO
LOOSEN LIMITS
100
YES
108
THERE IS AN ACTIVE CONSTRAINT(S) THAT RESTRICTS FURTHER IMPROVEMENT?
YES
110
OUTPUT THE ACTIVE CONSTRAINT

FIG_20

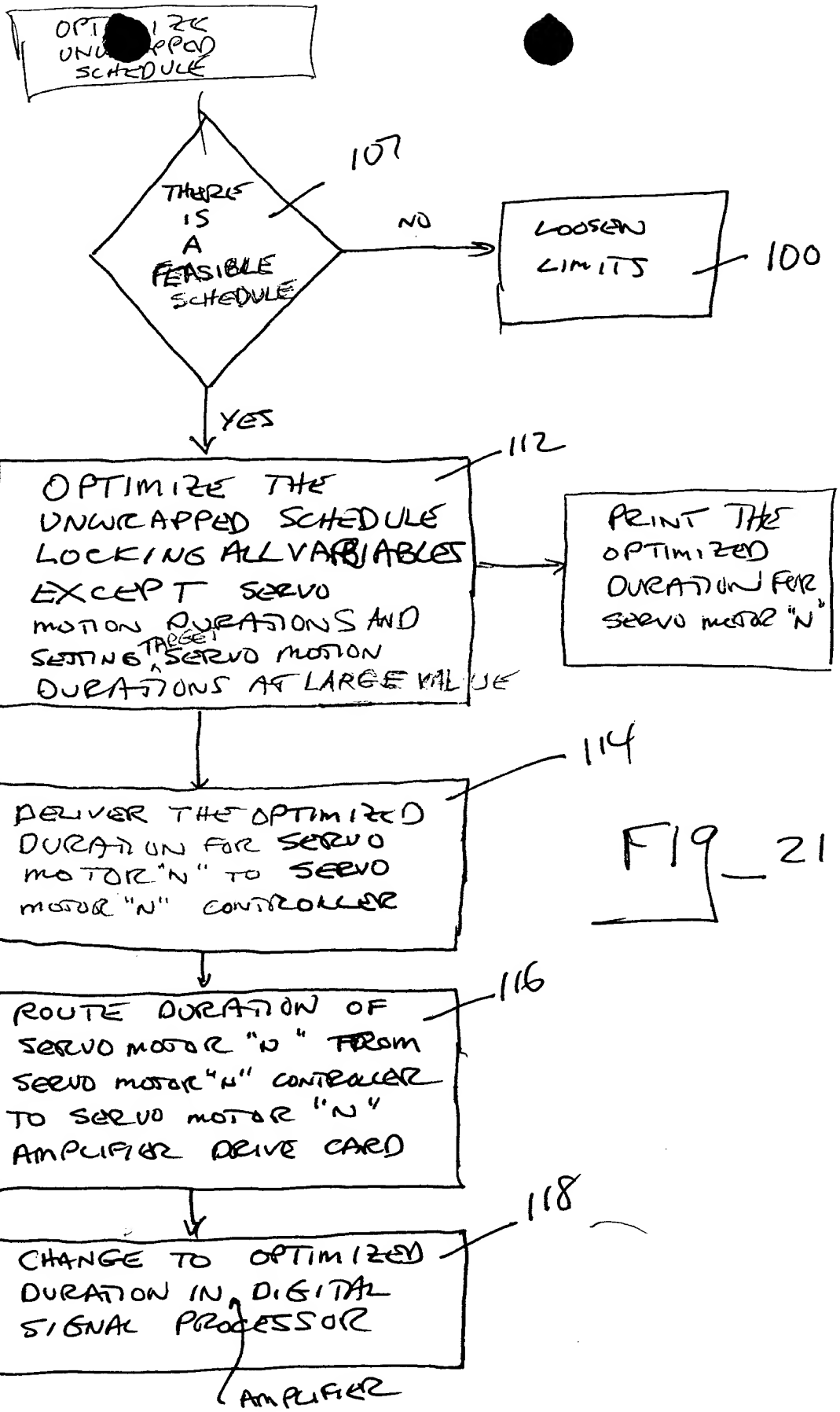
OPTIMIZE UNWRAPPED SCHEDULE
107
THERE IS A FEASIBLE SCHEDULE
NO
LOOSEN LIMITS
100
YES
112
OPTIMIZE THE UNWRAPPED SCHEDULE LOCKING ALL VARIABLES EXCEPT SERVO MOTION DURATIONS AND SETTING TARGET SERVO MOTION DURATIONS AT LARGE VALUE
PRINT THE OPTIMIZED DURATION FOR SERVO MOTOR "N"
114
DELIVER THE OPTIMIZED DURATION FOR SERVO MOTOR "N" TO SERVO MOTOR "N" CONTROLLER
116
ROUTE DURATION OF SERVO MOTOR "N" FROM SERVO MOTOR "N" CONTROLLER TO SERVO MOTOR "N" AMPLIFIER DRIVE CARD
118
CHANGE TO OPTIMIZED DURATION IN DIGITAL SIGNAL PROCESSOR
AMPLIFIER

FIG_21